NXP MOBILE ROBOTICS

Gerald Peklar
Mobile Robotics, Drones and Rovers.
System Innovations CTO R&D

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SECURE CONNECTIONS
FOR A SMARTER WORLD

About myself – Gerald Peklar

Electronics engineer

With NXP (Philips, Mikron) since 1995

RC model pilot, flying drones since 2014

Joined NXP mobile robotics team in 2015

Leading development projects (public funded / internal) in mobile robotics domain

NXP UAS test pilot

Representing NXP at UAV-DACH - https://www.uavdach.org/

Representing NXP at "Drohnenbeirat" of German Government

Member of Board of Directors at dronecode foundation - https://www.dronecode.org/

Member of ROS aerial WG

SECURE CONNECTIONS FOR A SMARTER WORLD

Our digitally enhanced world is evolving to anticipate and automate

NXP Semiconductors N.V. (NASDAQ: NXPI) enables a smarter, safer and more sustainable world through innovation. As the world leader in secure connectivity solutions for embedded applications, NXP is pushing boundaries in the automotive, industrial & IoT, mobile and communication infrastructure markets

NXP SEMICONDUCTORs WORLDWIDE

Together with our valued customers, we're not just advancing technology, we're advancing society.

60 years of combined experience and expertise

Operations in more than **30 countries** worldwide

Approximately **34,500 team members**

Headquarters in The Netherlands – **Eindhoven**

AUTOMOTIVE

Enabling carmakers to develop smarter solutions for complex autonomy, connectivity, and electrification challenges

Accelerating the shift to greater mobility

INDUSTRIAL

Reducing wasted time, money, and effort by helping business run more efficiently.

Enabling more efficient data processing

MOBILE

Giving wearable and mobile devices easier access to the services that make modern life more convenient without compromising security and safety.

Transforming how people and devices connect

SMART HOME

Solutions that listen, learn, and adapt into the places we call home for more comfort, affordability, safety, and convenience.

Powering the intelligence behind the technologies

SMART CITY

Simplifying how people access and interact with local services to achieve new standards of sustainability, efficiency, mobility, and economic growth.

Anticipating the demands of tomorrow

COMMUNICATION INFRASTRUCTURE

Powering insights and inspiring performance with hardware solutions for handling 5G connectivity across the emerging communications spectrum.

Delivering real-time responsiveness at the speed of 5G

NXP

A position of strength to better serve our 26,000+ customers

We accelerate breakthroughs that advance the world through our semiconductor technology leadership

EMPLOYEES IN
30+ COUNTRIES
Headquartered in Eindhoven, Netherlands

~34,500
TEAM MEMBERS

9,500
Patent Families

$13.21B
Annual Revenue [1]

60+
Year History

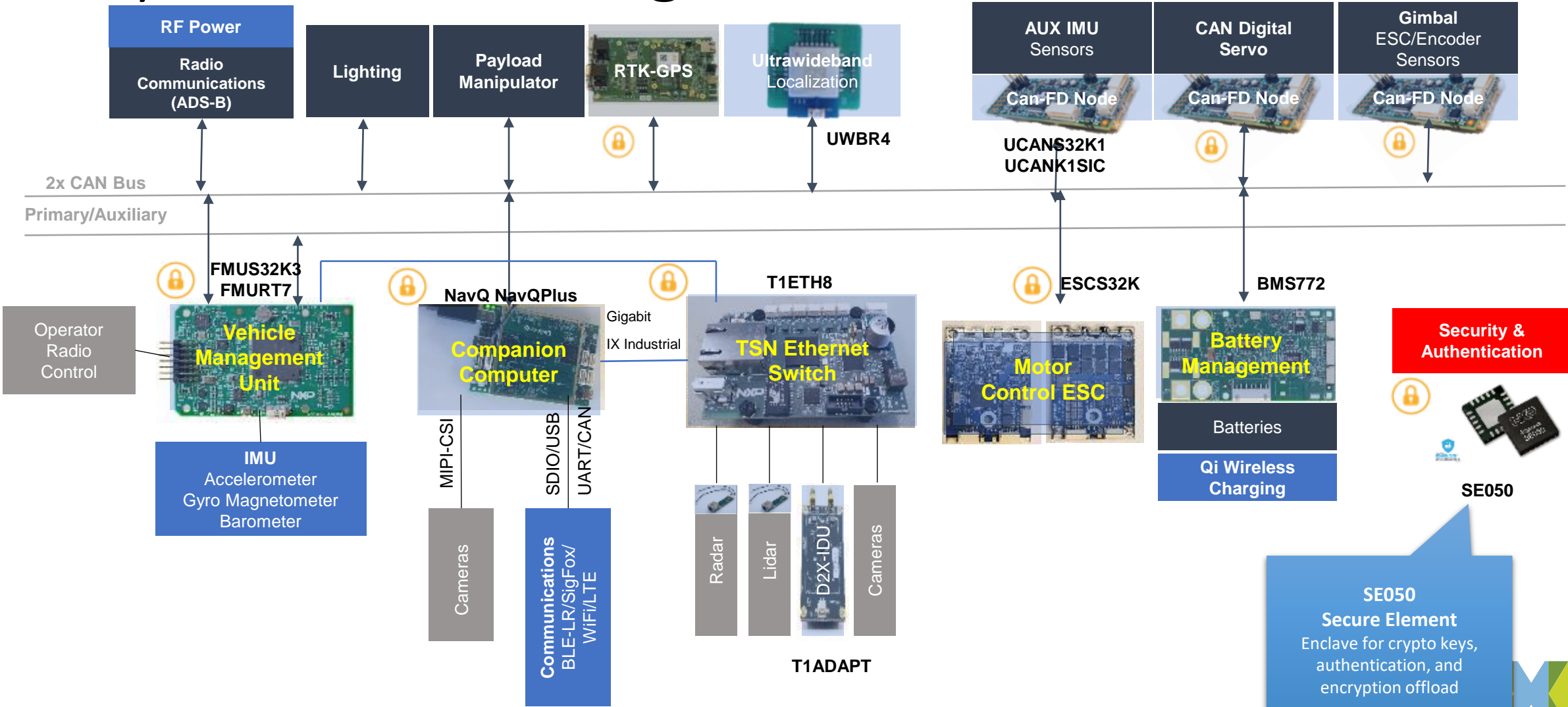## 11,000+
Engineers

Mobile robotics

Systems Block Diagram: Mobile Robotics

RF Power
Radio Communications (ADS-B)

Lighting

Payload Manipulator

RTK-GPS

Ultrawideband Localization
UWBR4

AUX IMU Sensors
Can-FD Node
UCANS32K1
UCANK1SIC

CAN Digital Servo
Can-FD Node

Gimbal ESC/Encoder Sensors
Can-FD Node

2x CAN Bus
Primary/Auxiliary

FMUS32K3
FMURT7

NavQ NavQPlus

Gigabit
IX Industrial

T1ETH8

ESCS32K

BMS772

Operator Radio Control

Vehicle Management Unit

Companion Computer

TSN Ethernet Switch

Motor Control ESC

Battery Management

Batteries

Qi Wireless Charging

Security & Authentication

SE050

IMU
Accelerometer
Gyro Magnetometer
Barometer

MIPI-CSI

SDIO/USB
UART/CAN

Cameras

Communications
BLE-LR/SigFox/WiFi/LTE

Radar

Lidar

D2X-IDU

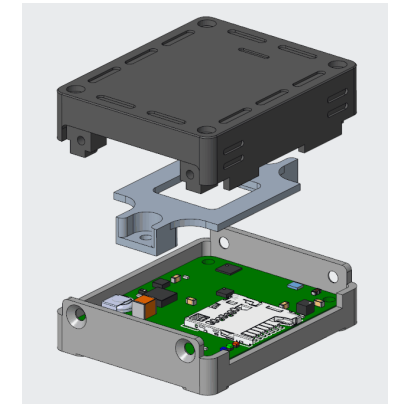Cameras

T1ADAPT

SE050
Secure Element
Enclave for crypto keys, authentication, and encryption offload

Next Generation Real time Vehicle Management Unit
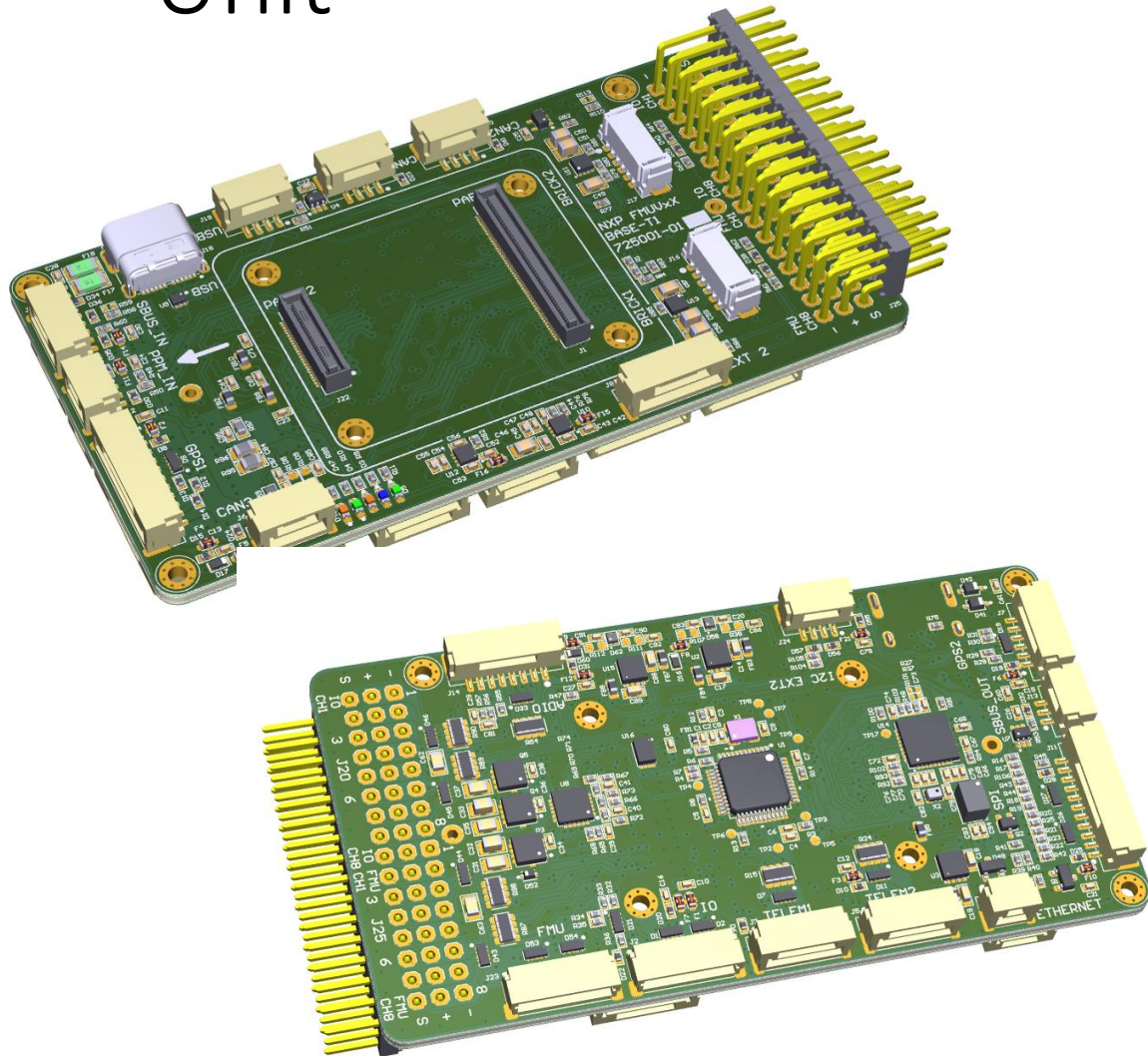
- GHz dual core MCU
- T1 Auto Ethernet
- CAN-FD
- IMUs

- NuttX
- PX4/NuttX
- Zephyr
- Cognipilot

NAVQPLUS MISSION COMPUTER

- Open reference design, NXP EVK SOM, with customization also available from 3rd party.

- Machine Learning using **2.3TOPS NPU accelerator,** eIQ ML Software development environment w/TFLite, ArmNN, ONNX

- **Yocto** Linux**, Ubuntu POC**** and **ROS2** enablement.

- Vision – Dual MIPI camera w/ ISPs, hardware codec accelerators

- WiFi 5 / BTLE 5.0

- Dual Ethernet 100BaseT1 "2-Wire" + IX industrial 1GB

- 2x USB-C with up to 20V power input + external power input

- SE050 EdgeLock secure element with NFC interface

- RTC with tamper timestamping

- PCIe expansion

- Supports up to three displays simultaneously MIPI,LVDS,HDMI (w/CEC)

  - Other uses include as a QGC ground station or smart remote controller, or machine interface terminal.

** Customized Ubuntu Core also available from Canonical

Available from NXP.com
Documentation on Gitbook

MR-T1ETH8

8Port 100base-T1 Ethernet switch

- 100BaseT1 "two wire" ethernet switch application reference design*
    - (6x) 100Base-T1 Two wire Ethernet
    - (1x) 100Base-TX Ethernet w/ traditional RJ45
    - (1x) 1000base-TX Gigabit w/ IX industrial connector

- NXP parts
    - <u>SJA1110</u> 10 port ethernet switch IC supporting TSN
    - VR5510 automotive PMIC
    - SE050 Secure Element with NFC interface
- Small 75x50mm board

Available from NXP.com

* Please use SJA1110-EVM for intensive development. This board intended only as a form-factor target following software vetting on EVM.

RDDRONE-BMS772
Battery Management board

- Battery management system with CAN-FD and SMBUS (i2c)

- Flexible - differentiated by MCU oversight of functions

- Multiple chemistries supported, security, certificates, active cell balancing

- NXP components

- MC33772 Automotive 6 cell BCC IC (MC33771 14 cell in discussion)

- S32K144 Automotive MCU

- A1007 Secure Element for authentication, secure cycle counts, flags

- NTAG5 NFC allows checking battery pack from mobile phone

- UJA1169 Systems basis chip

- OLED Display optional

- Software: NuttX OS + BMS libraries/applications

  Other uses: e-bike, scooter, power tools, portable medical
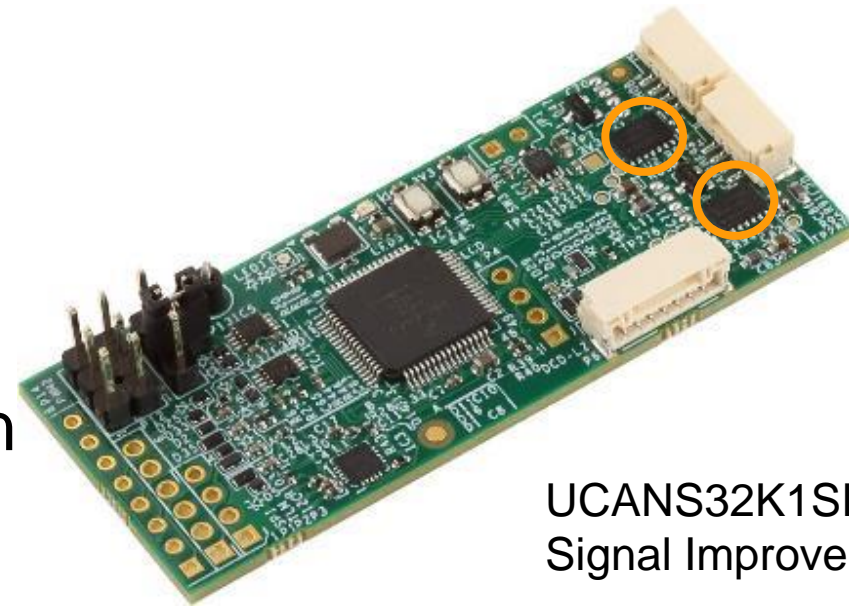
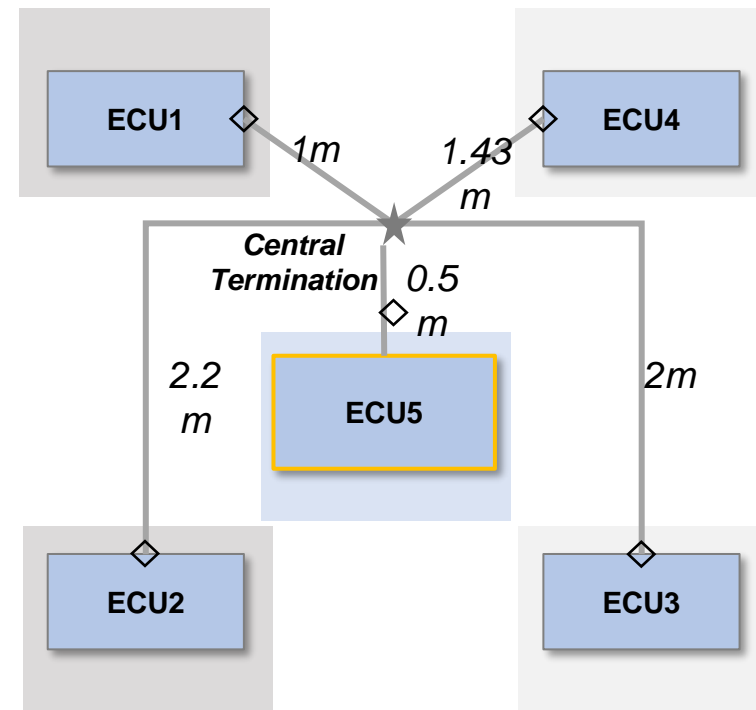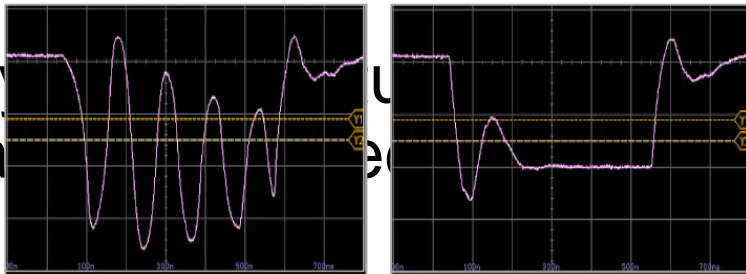**Available from NXP.com**

Documentation on Gitbook

UCANS32K1SIC UAVCAN node board

- Cost effective development boards for CAN-FD
  based sensor and actuator developmen

- Automotive S32K1 MCU

- Edgelock Secure Element with NFC

- PX4/NuttX RTOS or bare metal

- SIC Ph~~y~~u~~tral
  termina~~~~ec~~

UCANS32K1SIC
Signal Improvement CAN Phy

Available from NXP.com
Documentation on Gitbook

ECU1   1m   1.43 m   ECU4

Central Termination   0.5 m

2.2 m   ECU5   2m

ECU2   ECU3

HOVERGAMES

NXP

Introducing **HoverGames**
Interactive Coding & Hardware Challenge

Coders, engineers, developers and innovators around the world unite to solve society challenges – and you're invited to join.

Using the HoverGames development platform for autonomous drones and rovers, you'll build solutions that confront universal issues like disaster management, health crises, environmental protection, wildlife conservation and more.

Enhance your development skills and put them to the test with HoverGames!

What's in the **HoverGames** development platform?

Modular, open and extensible | Supported by DroneCode.org PX4 flight stack

The KIT-HGDRONEK66 includes components for a base platform, including:

- HoverGames Flight Controller, which features:
- 180 MHz NXP Kinetis Arm® Cortex®-M4 MCU
- On board IMU (accelerometer, gyro, magnetometer)
- Automotive CAN and 100Base T1 2-wire automotive Ethernet interfaces
- Standard PWM outputs, I2C, SPI, and UARTS
- Complete carbon fiber quadcopter drone frame

NOTE: The kit does not include a LiPo battery and a telemetry radio, which must be purchased for your region.

NXP I HoverGames

Who can join a **HoverGames** challenge?

Anyone, anywhere!

Whether you're a student getting your feet wet with more practical development experience, a young professional building your reputation and knowledge of robotic systems in a collaborative competition, or an experienced developer trying out newer technologies from encryption to artificial intelligence – you're invited.

By joining, you'll become part of a diverse, global community united in tackling a variety of problems.

https://www.hovergames.com/

NXP I HoverGames

NXP IN PROJECTS

- DLR - CityATM
  - Demonstration of traffic management in urban airspace
  - D2X 802.11p communication (Gen1)
  - E-Registration / e-Identificaton based on SE050 edgelock secure element
  - IEEE Whitepaper on D2X 802.11p
- BMVi - UDVeo
  - U-Space / Airspace management concept including demonstrator for Hamburg
  - D2X 802.11p communication (Gen2)
  - E-Registration / e-Identificaton based on SE050 edgelock secure element
- ECSEL – ADACORSA
  - Solution for BVLOS operation
  - Functional safe and secure drone reference design
  - Automotive ASIL certified HW, Redundant CAN and 100base-T1 bus communication
- Horizon Europe – HiConnects
  - 5G modem development
  - Drone and Rover demonstrator with radar sensors, UWB, 5G and SAT communication
  - Drone operation at wildfire use-case in Finland
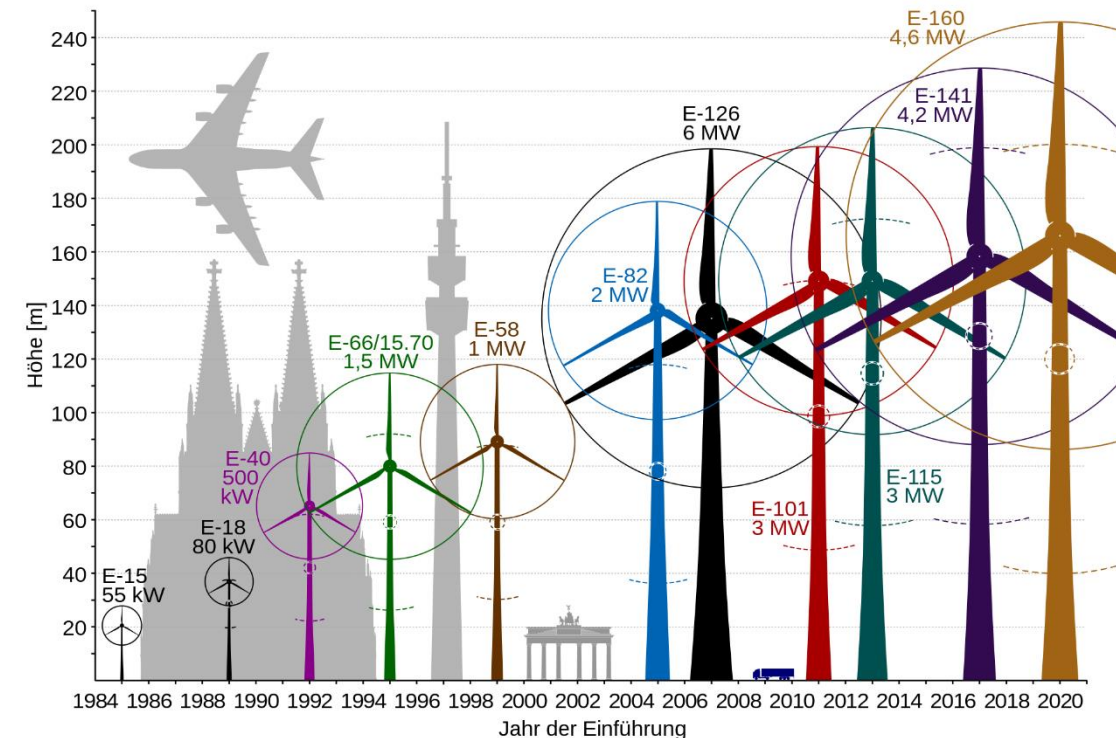
Drones4Bats

- Addressing the challenge between increasing green power and saving protected species
- Development of improved solution for detecting bats in wind parks by using drones
- **HAW**, NXP, WindStrom, Vespertilio

https://drones4bats.de/

Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

aufgrund eines Beschlusses des Deutschen Bundestages

Source: https://de.wikipedia.org/wiki/Windkraftanlage

The challenge

- Evaluation done with ultrasonic microphones, max range ~30m.
- Bats flying up to 10km high
- Wind turbines height up to 240m (hub at ~175m)

NXP task

- Development of full autonomous drone

- Automatic charging at landing pad

- Precision landing

- Automatic mission execution based on weather conditions

- Position and orientation of wind turbines to be incorporated.

Drones4Bats Project
First test flight of NXP drone

Gefördert durch:

Bundesministerium
für Wirtschaft
und Klimaschutz

aufgrund eines Beschlusses
des Deutschen Bundestages

NXP AEROSPACE AND MOBILE ROBOTICS

- Further information on solutions
  - https://www.nxp.com/uav
  - NXP Hovergames challenge https://www.hovergames.com/

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